The opinion in support of the decision being entered today
is *not* binding precedent of the Board

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte ROSWELL J. RUKA,
GEORGE R. FOLSER, and SRIKANTH GOPALAN

Appeal 2007-4240
Application 10/663,949
Technology Center 1700

Decided: October 31, 2007

Before CHUNG K. PAK, CHARLES F. WARREN, and
CATHERINE Q. TIMM, *Administrative Patent Judges*.

WARREN, *Administrative Patent Judge*.

DECISION ON APPEAL

Applicants appeal to the Board from the decision of the Primary Examiner rejecting for at least the second time claims 1 through 18 in the Office Action mailed August 25, 2006. 35 U.S.C. §§ 6 and 134(a) (2002); 37 C.F.R. § 41.31(a) (2006).

We reverse the decision of the Primary Examiner.

Claim 1 illustrates Appellants' invention of a tubular solid fuel cell, and is representative of the claims on appeal:

1. A tubular solid fuel cell, comprising:

an air electrode;

an electrolyte formed on at least a portion of the air electrode; and

a ceramic-metal fuel electrode having a microstructure characterized by accumulated molten particle splats formed on at least a portion of the electrolyte.

The Examiner relies upon the evidence in these references of record (Answer 2-3):

Jensen	5,035,962	Jul. 30, 1991
Cable	5,589,285	Dec. 31, 1996

T.A. Ramanarayanan, S.C. Singhal, and E.D. Wachsman (Ramanarayanan), "High Temperature Ion Conducting Ceramics," *Interface* 22-24 (The Electrochemical Society. Summer 2001).
R.M.C. Clemmer and S.F. Corbin (Clemmer[1]), "Processing and properties of porous Ni-YSZ metal/ceramic composites," *Metal/Ceramic Interactions* 241-243 (2002).

Appellants request review of the following grounds of rejection advanced on appeal (Br. 3-4):

Claims 1 through 4, 9 through 12, and 15 through 17 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over Ramanarayanan as evidenced by the prior art acknowledged by Appellants at page 3 of the Specification (Answer 8);

Claims 1 through 8 and 12 through 18 under 35 U.S.C. § 103(a) as unpatentable over Cable as evidenced by the prior art acknowledged by Appellants at page 3 of the Specification (*id.* 6);

[1] We do not find Clemmer listed on a PTO-892. However, this reference was first applied in the Office Action mailed November 15, 2004 at 7, and is contained in the electronic file as NPL Document dated November 15, 2004.

Claims 5 through 8 under 35 U.S.C. § 103(a) as unpatentable over Ramanarayanan in view of Jensen (*id.* 7);

Claims 9 through 11 under 35 U.S.C. § 103(a) as unpatentable over Ramanarayanan in view of Clemmer as evidenced by "INCO, Ltd."[2] (*id.* 8);

Claims 13 and 14 under 35 U.S.C. § 103(a) as unpatentable over Ramanarayanan (*id.* 9); and

Claim 18 under 35 U.S.C. § 103(a) as unpatentable over Ramanarayanan in view of Cable (*id.* 10).

The threshold issue in this appeal is whether, prima facie, Ramanarayanan, Cable, Jensen, and/or the prior art acknowledged by Appellants at page 3 of the Specification establish that Ramanarayanan and/or Cable would have described to one skilled in the art, with respect to anticipation, or would have suggested to one of ordinary skill in this art, with respect to obviousness, a tubular solid fuel cell comprising at least, among other things, a ceramic-metal fuel electrode having a microstructure characterized by accumulated molten particle splats formed on at least a portion of the electrolyte as specified by claim 1, the sole independent claim on appeal, as the Examiner contends.

The plain language of product claim 1 specifies a tubular solid oxide

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[2] "INCO, Ltd." is not listed on a PTO-892. "INCO, Ltd." was first applied along with Clemmer in the Office Action mailed November 15, 2004 at 7. A copy of "INCOFIBER® Nickel Coated Carbon Fibers," apparently from www.incosp.com, is attached to the Answer as recorded in the USPTO electronic file of this Application. This document does not appear to disclose "NiGr" in Clemmer Table III, or correspond to "Nickel coated graphite *particles* available from INCO" as relied on by the Examiner. Answer 8-9; Clemmer 223. A copy of "INCO Special products" is present in the NPL Document of November 15, 2004 which may correspond to "INCO, Ltd." as applied by the Examiner. In view of our disposition of this appeal, we do not remand this Application to the Examiner for clarification. *See* 37 C.F.R. § 41.50(a) (2007).

fuel cell (SOFC) comprising at least, with reference to Application Fig. 2, any manner of tubular air electrode (cathode) 14, at least a portion of which is surrounded by any manner of tubular electrolyte 16, that in turn is surrounded by tubular ceramic-metal fuel electrode (anode) 18. Specification, e.g., 7:18 to 10:17. The tubular ceramic-metal fuel electrode is characterized in that it has any manner of microstructure characterized by accumulated molten particle splats and is formed on at least a portion of the electrolyte.

Appellants disclose that plasma spraying by art recognized methods, e.g., by atmospheric plasma spraying (APS), vacuum plasma spraying (VPS), and flame spraying, a mixture of a metal powder and a ceramic powder will "form a generally uniform layer having a microstructure characterized by accumulated molten particle splats." Specification, e.g., 13:10 to 15:19. No other description of a method of providing a ceramic-metal layer having a microstructure characterized by accumulated molten particle splats is provided in the Specification.

We find the term "splat" is defined in context as "*vi* 1: To flatten on impact <shooting snowballs that splattered on the black trunks – Saul Bellow>." *Webster's Third New International Dictionary* 2200 (Philip Babcock Gove, ed., Springfield, Mass. Merriam-Webster Inc. 1993).

Accordingly, on this record, we determine that the claimed ceramic-metal electrode has a microstructure characterized by a surface having flattened areas of accumulated molten particle splats formed by plasma spraying a mixture of metal powder and ceramic powder, and thus, contrary to Appellants' arguments (Reply Br. 1-3), claim 1 is couched in product-by-process format even if a plasma spraying method is not specified per se.

See, *e.g., In re Thorpe*, 777 F.2d 695, 696-97 (Fed. Cir. 1985). We will not, of course, read illustrative embodiments into the claims as limitations. *See, e.g., In re Zletz*, 893 F.2d 319, 321-22 (Fed. Cir. 1989).

We find Ramanarayanan would have disclosed to one of ordinary skill in this art a tubular SOFC having an anode fuel electrode prepared "by forming a skeleton of [yttria-stabilized zirconia (YSZ)] around nickel particles" on the YSZ electrolyte. Ramanarayanan 23.[3] The YSZ electrolyte can be formed by, among other things, an electrochemical vapor deposition process (EVD) and "a more cost-effective non-EVD technique, such as plasma spraying or colloidal/electrophoretic deposition followed by sintering." *Id.* 23-24. The anode fuel electrode is a

> layer of nickel/YSZ . . . deposited by first applying nickel powder slurry over the electrolyte and then growing YSZ around the nickel particles by the same EVD process as used for depositing the electrolyte. Deposition of a Ni-YSZ slurry over the electrolyte followed by sintering has also yielded anodes that are equivalent in performance to those fabricated by the EVD process; use of this non-EVD process results in a substantial reduction in the cost of manufacturing SOFCs.

Id. 24.

We find Jensen would have disclosed to one of ordinary skill in this art that an anode fuel electrode can be formed in a manner "significantly less expensive than EVD" by "sintering a mixture of nickel and [YSZ] onto the

[3] We note here that, as pointed out by the Examiner, the Folser Declaration under 37 C.F.R. § 1.131 filed February 28, 2005, does not apply with respect to any of the references relied on in the grounds of rejection advanced on appeal because the references qualify as prior art under 35 U.S.C. § 102(b). *See* Answer 17; 37 C.F.R. § 1.131(a)(2) (September 2004). We further note Appellants did not cite this document in the Evidence Appendix to the Brief. Br. 18. Thus, we do not further consider this document.

electrolyte" in forming a SOFC. Jensen, e.g., col. 1, ll. 11-14, and col. 2, l. 40 to col. 3, l. 19.

We find Cable would have disclosed to one of ordinary skill in this art tubular SOFCs but illustrates the invention with planar SOFCs. Cable col. 6, ll. 13-22, col. 6, l. 55 to col. 7, l. 65, and Fig. 1. Electrolyte 6 can be YSZ that has a cathode electrolyte interfacial layer 18 of substantially cathode material applied thereto in the form of a paint or ink to form a contact zone. *Id.* col. 8, ll. 11-26. The

> anode electrolyte interfacial layer 19 may be applied to the surface of the electrolyte adjacent or proximate to the anode as a paint or ink containing, in one embodiment, substantially anode material such as nickel or nickel oxide, to form . . . an electrical contact zone . . . [and] may be applied by other conventional techniques also, such as plasma deposition, spin casting, spraying or screen printing.

Id. col. 8, ll. 26-34. The "[a]node 4 is a porous body, and may comprise a finely divided, compressed metallic powder such as nickel or cobalt blended with a stable oxide powder such as zirconia, ceria, yttria or doped ceria." *Id.* col. 10, ll. 18-21. There is no disclosure that "plasma deposition" includes plasma spraying and the Examiner admits Cable "does not explicitly teach plasma spraying the actual fuel electrode layer." Answer 6.

A discussion of Clemmer is not necessary to our decision.

Appellants acknowledge it was known in the art to form an anode fuel electrode by EVD of YSZ "within and surrounding nickel particles, thereby forming a [YSZ] 'skeleton' within and around a matrix of nickel particles." Specification 3:1-5. Appellants acknowledge the sintering process of forming the anode fuel electrode from a mixture of nickel and YSZ as disclosed by Jensen. *Id.* 3:11-14. Appellants acknowledge forming the

anode fuel electrode by plasma spraying, including APS, VPS, and flame spraying "a molten powdered metal or metal oxide onto an underlying substrate surface using a plasma thermal spray gun to form a deposited layer having a microstructure generally characterized by accumulated molten particle splats." *Id.* 3:16-4:6.

We, like Appellants, find no disclosure in Ramanarayanan which would have described to one skilled in this art or suggested to one of ordinary skill in this art that the anode fuel electrode of nickel in the YSZ skeleton for the SOFCs disclosed therein can be formed on the surface of the YSZ electrolyte by plasma spraying a mixture of nickel and YSZ powders as the Examiner contends. *See* Answer, e.g., 4-5, 7-8, 9-10, 12-13, and 15-16; Br. 6-7; Reply Br., e.g., 4. Indeed, neither of the two specific methods disclosed by Ramanarayanan to deposit the specific anode fuel electrode skeletal structure involves plasma spraying, and Ramanarayanan's statement that the deposition of the Ni-YSZ skeletal structure by depositing a slurry of the materials followed by sintering is less costly compared to EVD is further supported by the same disclosure in Jensen. Appellants acknowledge that the EVD method of depositing the Ni-YSZ skeletal structure was known. Cable does not disclose forming any layer of SOFC by plasma spraying. Thus, we are further not convinced by the Examiner's contention that one skilled in the art and one of ordinary skill in the art would have formed the Ni-YSZ skeletal structure because of the knowledge in the art that YSZ can be cost effectively deposited as the electrolyte by plasma spraying compared to EVD as disclosed by Ramanarayanan, and that plasma spraying of metals was known as Appellants acknowledge. *Cf., e.g., In re Graves*, 69 F.3d 1147, 1152 (Fed. Cir. 1995), and cases cited therein (a reference anticipates

the claimed method if the step that is not disclosed therein is within the knowledge of the skilled artisan). Indeed, the Examiner adduces *no* reference establishing that plasma spraying a mixture of metal-ceramic powders can provide Ramanarayanan's Ni-YSZ skeletal structure, and mere cost-benefit analysis alone does not established that this structure would be formed in this manner.

We determine the ground of rejection over Cable is not supported by evidence establishing obviousness in the same respects. *See* Br., e.g., 10; Reply Br., e.g., 5. Indeed, the Examiner admits Cable does not explicitly teach plasma spraying the actual furl electrode layer, and thus, this reference alone provides no support for the Examiner's contention that "it would be obvious to one skilled in the art at the time of the invention to recognize plasma spraying as a viable option for applying the anode material" in Cable. *See* Answer 6. Indeed, the Examiner's contention that "Cable further teaches applying a substantially furl electrode material (anode) to the electrolyte using plasma spraying (8:30-35)" is not supported by that disclosure. *See* Answer 16. In this respect, the "substantially anode material" disclosed by Cable at col. 8, ll. 30-35, is nickel and nickel oxide, and Cable at col. 10, ll. 18-21 (emphasis supplied), discloses that the anode " is a porous body and may comprise a *finely divided, compressed* metallic powder," such as nickel blended with a stable oxide powder, such as zirconia or yttria. The Examiner does not establish that Cable's thus described porous body anode fuel electrode has a metal-ceramic microstructure characterized by accumulated molten particle splats formed on at least a portion of the electrolyte as claimed.

Accordingly, the Examiner has not established a prima facie case of anticipation or of obviousness under 35 U.S.C. §§ 102(b) and 103(a) in the grounds of rejection applying Ramanarayanan, and of obviousness under 35 U.S.C. § 103(a) in the ground of rejection over Cable alone, and accordingly, we reverse the grounds of rejection of claims 1 through 18.

The Primary Examiner's decision is reversed.

REVERSED

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